

A NEW SPECIES OF *PEDIOMELUM* (FABACEAE) FROM THE LOWER PIEDMONT PLATEAU OF GEORGIA AND SOUTH CAROLINA

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ABSTRACT

In the Piedmont Physiographic Province of the southeastern U.S.A., the endemic North American genus *Pediomelum* is known only from three dry, rocky, partly open sites near the Fall Line. The first collections were made in 1984, from Richland County, South Carolina; in 1996, from more than 100 km. to the west, in Columbia County, Georgia; and in 2005, from Lexington County, South Carolina, less than 20 km from the Richland County site. The two late-twentieth-century collections were referred, with reservations, to *P. canescens*, a species of sandy soils on the adjacent Atlantic Coastal Plain. This was the only known *Pediomelum* that resembled the Piedmont plants in having the petioles shorter than the petiolules and the only similarly erect and caulescent species east of the Mississippi River. Subsequent collections and study by the authors indicate that the Piedmont populations share a consistent morphology that is unique within the genus in combining subsessile leaves with congested, many-flowered inflorescences. These plants differ from *P. canescens* in additional ways (e.g., fruiting calyces gibbous and more narrowly campanulate, bracts conspicuously larger and broader, and leaflets more narrowly elliptic). The Piedmont plants also cannot be considered a sessile-leaved variant of any of the western species, and therefore they are described as *Pediomelum piedmontanum* Allison, Morris, & Egan, sp. nov.

RESUMEN

En la Provincia Fisiográfica de Piedmont del sureste de EEUU, el género *Pediomelum*, endémico de Norteamérica, se ha encontrado solamente en tres sitios secos y rocosos y parcialmente abiertos que están cerca de la Fall Line. Las primeras colecciones se hicieron en 1984 en el Condado de Richland, Carolina del Sur; en 1996, a más de 100 km al oeste, en el Condado de Columbia, Georgia; y en 2005 en el Condado de Lexington, Carolina del Sur, a menos de 20 km del sitio en el Condado de Richland. Las dos colecciones de finales del siglo XX se refirieron, con reservas, a *P. canescens*, una especie de los suelos arenosos en el Atlantic Coastal Plain contiguo. Este era el único *Pediomelum* conocido que se asemejaba a las plantas del Piedmont en tener los pecíolos más cortos que los peciólulos y la única especie semejante al este del Río Mississippi erguida y caulescente. Las colecciones subsiguientes y los estudios por los autores indican que las poblaciones del Piedmont comparten una morfología coherente que es única dentro del género en combinar las hojas subsésiles con las inflorescencias congestionadas y multifloras. Estas plantas se diferencian de *P. canescens* de otros modos (p. ej., los cálices fructíferos gibosos y más angostamente campanulados, las brácteas visiblemente más grandes y más

anchas, y las hojuelas más angostamente elípticas). Las plantas del Piedmont tampoco se pueden considerar como una variante, con las hojas subsésiles, de cualquiera de las especies occidentales, y por lo tanto se describen como *Pedimelum piedmontanum* Allison, Morris, & Egan, sp. nov.

HISTORICAL SKETCH

“This specimen is an enigma.” So began Duane Isely (1918–2000) in his 1991 annotation of *J.S. Angerman s.n.* (USCH), a South Carolina specimen whose original label bears a date (June 8, 1984) but lacks any name for the plant. Above this label is an annotation slip with James Grimes’ 1991 determination as *Pedimelum cuspidatum* (Pursh) Rydb., made the year after publication of his monograph (1990) of *Pedimelum* Rydb. and other genera of New World legumes often treated at the time as components of a single broadly-defined genus, *Psoralea* L. Grimes’ determination of *Angerman s.n.* as *P. cuspidatum* must have preceded Isely’s annotation, which was manifestly written in dissent:

This specimen is an enigma. It is not *Pedimelum cuspidatum*, which is a species of the Great Plains. The leaves of *P. cuspidatum* are petioled and 3–5 foliolate. These are sessile and 3-foliate. The only *Pedimelum* currently known in South Carolina is *P. canescens*. It matches this to the extent that the leaves are shortly petioled or subsessile, but the inflorescence is entirely different.

Clearly as a result of seeing these remarks, Grimes took another look at *Angerman s.n.*, making some floral dissections and measurements of the parts (as recorded in pencil drawings on the sheet) that were the basis for his second annotation, which he attached above Isely’s, with reasons why the specimen also did not fit typical *Pedimelum canescens* (Michx.) Rydb. (pubescence, leaf shape, number of floral nodes, length of lower calyx-tooth and of wing-petals). Before concluding this annotation with the results of his floral dissection, Grimes wrote that the plant probably merits varietal rank. We assume he meant under *P. canescens*, since he confined his comparison to that species, *sensu stricto*, though his unelaborated determination of three months earlier as *P. cuspidatum* was not explicitly retracted.

In 1996, five years after the Isely and Grimes annotations but without knowledge of them, Thomas S. Patrick of the Georgia Natural Heritage Program (GNHP) made the next known collection of a *Pedimelum* from the Piedmont Plateau (*Patrick s.n.*, GA, NY). It came from a locality with unusual geology (serpentinite and related rocks) near the Savannah River in Columbia County, Georgia. Patrick identified the legume using Radford et al. (1968), in which, due to the palmately foliolate and essentially sessile leaves, it keys to *Psoralea canescens* Michx. (= *Pedimelum canescens*), a species known from the nearby Atlantic Coastal Plain sandhills of Georgia and South Carolina, as indicated in Radford et al. That the habitat of *Patrick s.n.* was a rocky place in the Piedmont did not militate against such an identification, as the site supports a natural community with a mix of Piedmont and Coastal Plain flora. Among the latter are *Pinus palustris* P. Mill. (longleaf pine), very rare in the eastern two-thirds of

the Piedmont of Georgia, and *Marshallia ramosa* Beadle & F.E. Boynt. (Asteraceae), a state-protected rarity otherwise endemic to the Coastal Plain.

In June 1999 Morris encountered this same Georgia population of *Pediomelum* and collected Morris 4558 (Herbarium of North Georgia College and State University, "NGCSU"). At the time, he was unaware of both the 1984 specimen at USCH and Patrick's *Pediomelum* collection (then stored at GNHP). After trying to identify his collection using Isely (1990) and finding that, because of the leaf shape and dense inflorescences (Figs. 1, 2), the plant did not key straightforwardly to any species, Morris showed his collection to Allison, who had the benefit of familiarity with *P. canescens*. Noting at once the much showier inflorescences and proportionately narrower leaves of Morris' collection, Allison believed it must either represent a new species or a long-range disjunct. After obtaining the two most recent monographs of the group (Ockendon 1965; Grimes 1990), Allison, Morris and Patrick agreed that the plants appeared to represent a new species. An abstract reporting these findings, but without knowledge of the specimen from South Carolina, indicated the intention to name the new species *Pediomelum georgianum* (Allison et al. 2003).

In 2004 Egan undertook a study of the phylogenetics, biogeography, and diversification of North American Psoraleeae (Egan & Crandall 2005). In advance of field sampling of the group, she made inquiries about localities with recent collections or observations of the various taxa. While inquiring about South Carolina localities for *Pediomelum canescens*, Egan was alerted by the curator of USCH, John Nelson, about the "enigmatic" South Carolina collection. After borrowing it, she agreed with Isely and Grimes that it was not a clear match for any described taxon and sought out the actual living plants. In June 2005, Egan found the plant at the likely original collection site, in Richland County, and also discovered a population about 19 km away in Lexington County. The consistent and distinctive morphology confirmed her suspicion that it was a new species. Internet research led her to a listing (GNHP 2004) of an undescribed *Pediomelum* on a roster of Georgia rare plants, resulting in her contacting Allison.

After comparison of all the known specimens of Piedmont *Pediomelum*, from Angerman s.n. through Allison's September 2005 collections of the first fruiting material from the South Carolina sites, we have concluded that these occurrences of *Pediomelum*, one in Georgia and two in South Carolina (Fig. 3), are all of the same, undescribed species, with a provisional *nomen nudum* of *P. georgianum*. The delay in formal description permits us to give the new species a more appropriate specific epithet:

Pediomelum piedmontanum J.R. Allison, M.W. Morris & A.N. Egan, sp. nov. (**Fig. 2**). TYPE: UNITED STATES. GEORGIA. Columbia Co.: ca. 12 km NE of Appling. Dixie Mountain, 20 Jul 2001, James R. Allison & Michael Wayne Morris 12764 (HOLOTYPE: NY; ISOTYPES: BRIT, BRY, FLAS, GA, GH, MISS, MO, NGCSU, NLU, NY, PH, US, USCH, VSC).



FIG. 1. Upper portion of a plant of *Pedimelum piedmontanum*, with the characteristic dense, many-flowered inflorescences and leaves all more than twice as long as wide. Columbia County, Georgia, 15 Jun 2002.

Inter species *Pedimeli* subgeneris *Pedimeli* sensu Grimesii petiolis brevioribus quam petiolulis ad *P. canescens* solum accedit, autem simul est *P. reverchonio* soli simile bracteis floralibus magnis et latissimis et valde caudatis, sed ab ambobus statim distinguitur inflorescentiis densis et multifloris.

Plant an erect, strigose and glandular-punctate perennial herb 0.5–0.8(–1) m tall; root deep, woody, fusiform, branching, rough-furrowed, to at least 1.5 cm wide \times 15 cm long (Fig. 4D). **Stems** each senescing and detaching at ground level promptly after maturation of fruit, including the persistent infructescence; in life 1–few, to 6 mm in diameter, branching usually a little below the middle, with exfoliating scaly epidermis below, sometimes purplish toward base, striate, blond to dark brown punctate-glandular, and strigose (hairs 0.4–0.9 mm long), often with remnants of cataphylls, these usually only one or two, remote, and some distance from base, 6–10 mm wide \times 6.5–9 mm long, obviously veined, sometimes bifid. Stipules erect, persistent, linear-lanceolate, 7–12 mm long \times 6.5–9 mm wide, papery, very sparingly strigose, obviously veined, the lower ones sometimes fused-free, free above. **Leaves** palmately 3(–5)-foliolate (Figs. 1, 2, 4B); petiole (0–)1–2.4(–4) mm long (reduced upward), terete to more usually slightly canaliculate, sparingly strigose, not jointed to the stem and not swollen at the



PLANTS OF GEORGIA
Columbia County

Pediomelum piedmontanum J. R. Allison,
M. W. Morris, & A. N. Egan

Ca. 12 km NE of Appling. Dry, rocky openings and
thin woods on Dixie Mountain

HOLOTYPE

James R. Allison & M. Wayne Morris 12764 July 20, 2001

FIG. 2. Holotype of *Pediomelum piedmontanum*, prior to its deposit at NY.

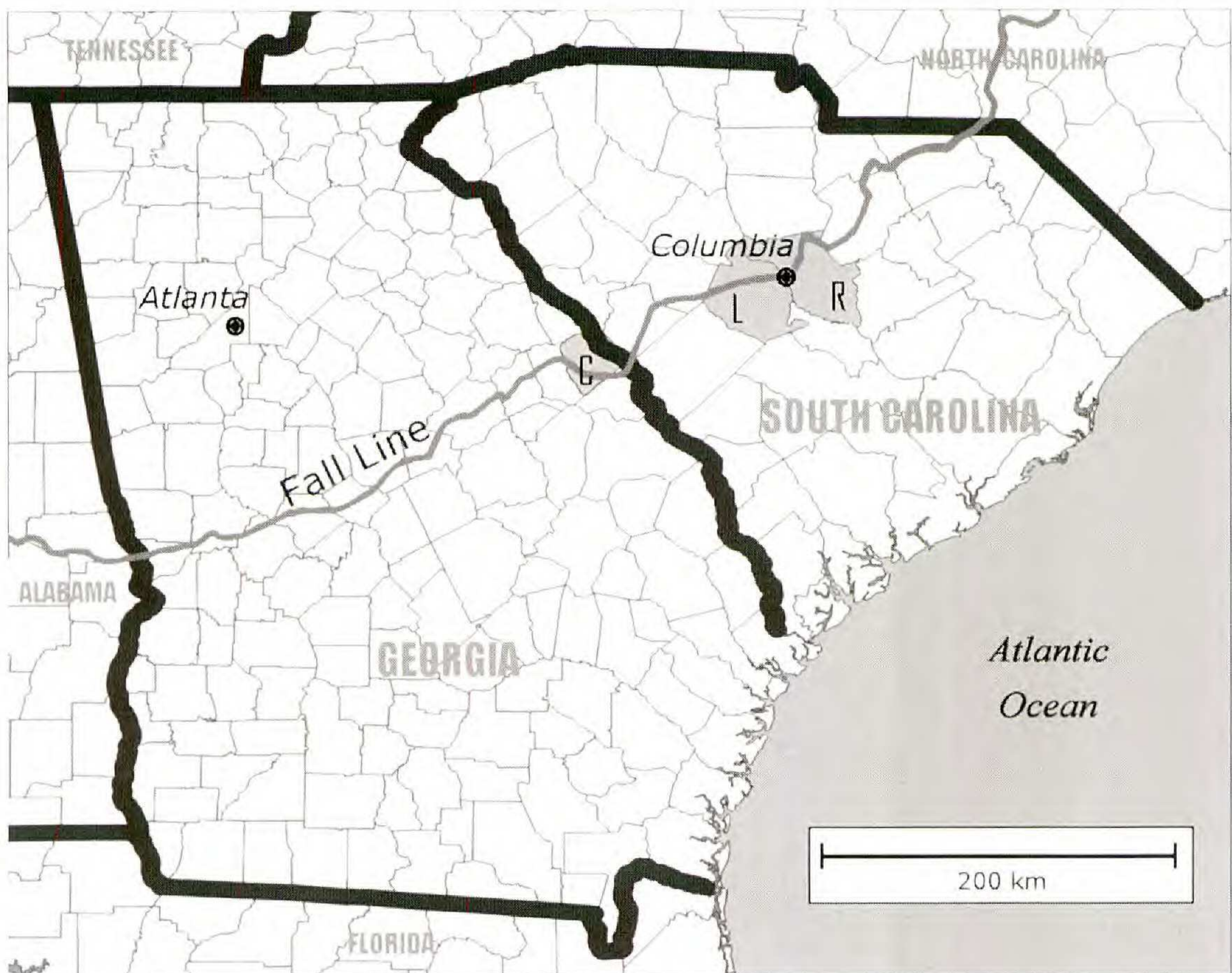


FIG. 3. County outline map showing Georgia, South Carolina, their capital cities, and portions of adjacent states. Counties with known occurrences of *Pediomelum piedmontanum* (all north of but near the Fall Line) are marked with the first letter of the county name (Columbia, Lexington, Richland) and shaded. Based on a county outline map of the southeastern U.S.A., downloaded from <http://www.amaps.com/>, with the approximate location of the Fall Line traced from Physical Map of the Southeast, copyright 1967 by Wilbur H. Duncan.

base, shorter than petiolules or petiole lacking and petiolules attached directly to leaf spur; petiolules usually darker in color than petiole, strigillose, 1.8–3 mm long; leaflets narrowly to broadly elliptic, (0.4–)0.6–2.7 cm wide \times (1.0–)1.2–5(–5.5) cm long, apex rounded or shallowly retuse, often mucronate, basally cuneate, strigose-ciliate, upper surface sparingly strigose, especially on midvein, lower surface usually slightly paler and more abundantly strigose, both surfaces densely dark-glandular. **Inflorescence** a dense, many-flowered pseudoraceme, in outline [ovate or] elliptic to oblong, (2.1–)2.5–5.7 cm long, with (4–)6–13(–15) nodes and (1–)3(–4) flowers per node; peduncle 0.6–2.8(–3.4) cm long, base of same color and texture, not jointed to stem; rachis (1–)2–5(–5.5) cm long, elongating only slightly in fruit, usually some or most of the nodes in subopposite pairs, internodes (0.5–)1–6(–10) mm in length; bracts conspicuous, enclosing the calyx, persistent, broadly ovate to suborbicular, caudate at apex, body 8–11.5 mm wide \times (7–)9–10 mm long, densely amber- to dark

brown-glandular in age, often purplish-tinged distally, especially the 4.5–7(–8) mm long tail; pedicels 1.1–3 mm long, pubescent. **Flowers** (Fig. 4A) 12.5–14 mm long; calyx (10–)12–13 mm long to upper teeth, 12–16 mm to lower tooth, the tube green or sometimes suffused with violet, 4–5 mm long, nearly glabrous internally, externally more or less pilose, at least below the lower tooth, and amber- to dark brown-glandular except for the gibbous area, sometimes largely eglandular except along the vein running into each of the upper and medial teeth, the teeth linear-lanceolate, darker green and often tinged with violet, at least distally, copiously pilose-ciliate proximally and sparsely so distally, the upper four teeth 4–8 mm long \times 1–1.5 mm wide, nearly glabrous on both surfaces or internally more or less sericeous, the lower tooth (6–)7–11(–11.5) mm long \times 1.5–3 mm wide, internally sericeous, proximally externally pilose, the calyx in fruit strongly gibbous-campanulate, with a vein to the apex of each tooth and one to each sinus, those to the sinuses bifurcating and continuing as submarginal veins more than 3/4 the length of the tooth; petals violet to lavender, or cream to yellowish with tinges of violet on wings and keel; banner obovate or broadly oblanceolate, (8.5–)10–14 mm long \times 5.5–7 mm wide, the claw (3.5–)4.5–7 mm long, the blade shallowly emarginate or occasionally truncate, low-biauriculate, the auricles scarcely internally callose; wings (7–)8–12 mm long \times 2–2.5 mm wide, the claw (3–)4–6 mm long, the auricle 1–1.5 mm long; keel petals (5–)6–10 mm long \times 2–2.5(–3) mm wide, the claw (3–)4–5 mm long, the blade with a darker violet blotch apically, occasionally very slightly apiculate; androecium 9.5–11 mm long, apically calyciform, anthers obovoid-elliptic, 0.5(–0.75) mm long; gynoecium 8–9 mm long, ovary glabrous, style glabrous or sometimes strigillose at the base. **Fruit** body broadly elliptic to slightly obovate in profile, 6–7 mm long \times 4–4.5 mm wide, glabrous, densely amber- to dark brown-glandular, narrowed (but not abruptly) to the arcuate beak, which is (5–)6–8 mm long \times 2–3 mm wide, glandular like the body, adaxial surface sparsely short-pubescent, distinctly longer than the calyx teeth and strongly exserted (Fig. 4C). Seed weakly reniform, 3.5–5 \times 2.5–3.5(–4) mm, compressed but not flattened, nearly smooth, gray-brown (Fig. 4E). **Flowering** late May–late June (–late July), fruiting July–August(–September).

Habitat and range.—Apparently endemic to rocky, open areas and adjacent open woodlands in the lower Piedmont Plateau of Georgia and South Carolina (Fig. 3).

PARATYPES. U.S.A. GEORGIA. Columbia Co.: (topotypes): 16 Jun 1996, *Patrick s.n.* (GA, NY); 21 Jun 1999, *Morris 4558* (NGCSU, NLU); 25 Aug 2001, *Allison et al. 13001* (GA); 2 Jun 2002, *Morris 4971* (NGCSU, NLU, SWSL); 15 Jun 2002, *Allison & Morris 13423* (CLEMS); 5 Sep 2002, *Allison 13459* (MO, VSC); 25 Jul 2003, *Allison 13611* (FLAS, GH, NY, US), *Allison 13613* (MICH); 19 Aug 2005, *Morris 5039* (NGCSU); 24 Aug 2005, *Allison & Morris 13777* (NCU); 18 Sep 2005, *Williams & Morris 55* (NGCSU); 27 Sep 2005, *Allison 13813* (AUA, FSU, GA, JSU, PH, TENN, UNA). **SOUTH CAROLINA. Lexington Co.:** 23 km NW of Columbia, 5 Jun 2005, *Egan & Egan 263* (BRY, NY); 25 Sep 2005, *Allison 13800* (BRY,

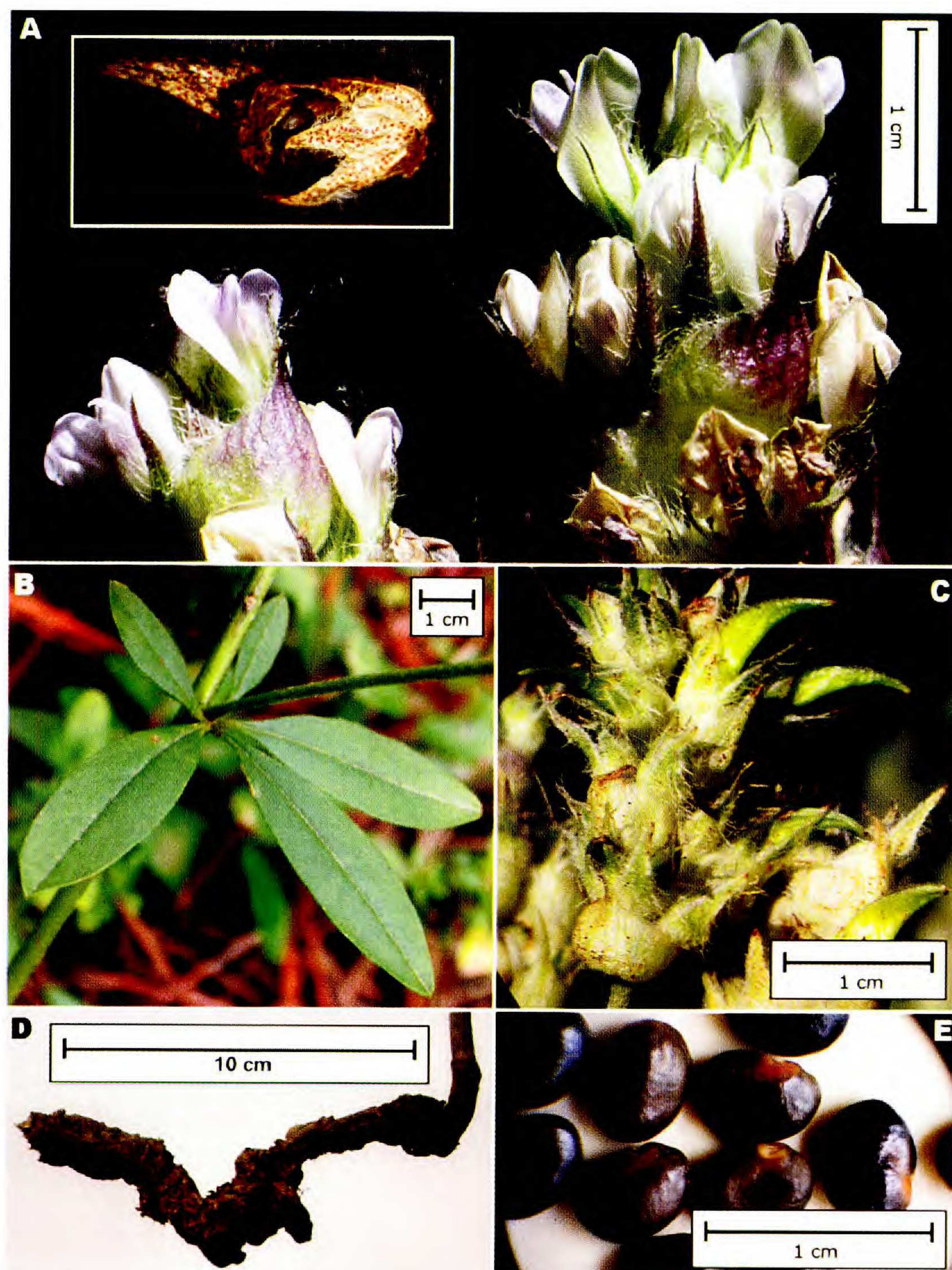


FIG. 4. Some details of *Pedimelum piedmontanum*, all from the type locality in Columbia County, Georgia. **A:** distal portions of two inflorescences, showing corollas and—strongly tinged with violet distally—the large and caudate bracts that conceal the calyces except for the slender calyx-teeth, the apices of the latter also tinged with violet; 15 Jun 2002; inset: transverse rupture of a fruit (partly included in calyx), characteristic of the genus *Pedimelum*; from Allison 13611 (collected 25 Jul 2003). **B:** a 5-foliolate leaf, uncommon in this species and unknown in *P. canescens*, but frequent in many of the more western spp.; 24 Aug 2005. **C:** an immature infructescence showing the large, arcuate, and strongly exerted beaks of the fruits, greener in the unripe state than the bracts, and longer and broader than the calyx teeth; 25 Jul 2003. **D:** proximal portion of root; from Allison et al. 13001 (collected 25 Aug 2001). **E:** seeds; from Allison 13611 (collected 25 Jul 2003).

CLEMS, MO, TAMU, TEX, USCH, VDB); 26 Sep 2005, *Allison* 13808 (GH, NY, US). **Richland Co.:** 26 km NW of Lexington, 8 Jun 1984, *Angerman* s.n. (USCH; labeled, apparently in error, as from Lexington County); 5 Jun 2005, *Egan & Egan* 262 (BRY, K, NY); 25 Sep 2005, *Allison* 13801 (BRIT, CLEMS, NCU, USCH); 26 Sep 2005, *Allison* 13803 (BRY).

COMPARISONS WITH CONGENERS

Within the papilionoid legumes (whether treated as a family or subfamily), two tribes, the Psoraleeae (Benth.) Rydb. and the Amorpheae Boriss., are characterized by 1-seeded, indehiscent fruits and (usually) glandular foliage. The Amorpheae produce terminal inflorescences and mostly pinnately divided leaves, while the Psoraleeae have inflorescences that technically are axillary and leaves mostly palmately divided (Barneby 1977). Taxonomists have treated the Psoraleeae as consisting of a single diverse and widespread genus, *Psoralea* (e.g., Cronquist 1981), or as composed of a narrowly circumscribed *Psoralea* and several genera segregated from it (e.g., Rydberg 1919–1920). In the most recent monograph covering North American Psoraleeae, Grimes (1990) took the latter approach, following Stirton (1981) in restricting application of *Psoralea* to a few species of the Old World (typified by *P. pinnata* L.) that have solitary flowers in fascicles subtended by lobed cupula, while the inflorescences of the New World segregates are pseudoracemes (racemelike in appearance, but some or many of the nodes with two or more flowers). Grimes apportioned all of the New World Psoraleeae to segregate genera, many of them proposed earlier by Rydberg but not as rigorously defined by him. Grimes' generic reassignments have gained broad acceptance, aided by their prompt adoption by Isely (1990).

The prime characteristic of *Pedimelum*, according to Grimes (1990), is a transverse rupture of the pod (inset, Fig. 4A), the base remaining attached to the receptacle after the beaked distal portion and seed fall away. The genus was divided by Grimes into three subgenera. *Leucocraspedon* Grimes consists of two trailing species of south-central U.S.A. with pinnately-divided leaves, reddish to ochroleucous flowers, and a white ridge surrounding the hilum. The other two subgenera have mostly palmately divided leaves, flowers mostly lavender to bluish-violet, and the hilum not ringed by a white ridge. Subgenus *Disarticulatum* Grimes comprises nine acaulescent or shortly-caulescent species (one composed of two varieties) in which the infructescence disjoints in age at the peduncle-base. Only one species of subgenus *Disarticulatum* occurs east of the Mississippi River (Grimes 1990): *P. subacaule* (Torr. & Gray) Rydb., of calcareous pavement outcrops (cedar glades) of the Interior Low Plateau of Tennessee and Alabama (Nashville Basin and Highland Rim), and more rarely the Ridge and Valley of Alabama (Allison & Stevens 2001) and Georgia (Baskin & Quarterman 1970), the Georgia occurrences about 300 km to the northwest of the Georgia site for *P. piedmontanum*.

The remaining 10 of the 21 *Pedimelum* species accepted by Grimes, with

the addition of *P. piedmontanum*, constitute subgenus *Pedimelum*, with persistent infructescences and a caulescent habit. It is not clear, based on morphology, which of these species is most closely related to *P. piedmontanum*. As the morphological data are supplemented with molecular analyses, evolutionary relationships within *Pedimelum* should become clearer.

Geography and subsessile leaves do not establish a close affinity to the nearly sympatric *Pedimelum canescens*, when weighed against the very different inflorescences of *P. piedmontanum*, many-flowered and persistently congested. The latter are similar, at least in appearance, to those of certain species of western U.S.A., where the subgenus is much more widespread and diversified. The occasional development in *P. piedmontanum* of 4- or 5-foliolate leaves (Fig. 4B) also suggests a closer affinity to some of the western species, as such leaves are unknown in *P. canescens* but typical of such species of the Great Plains as *P. cuspidatum* and *P. esculentum* (Pursh) Rydb. In his monograph, Grimes (1990) opined that there are two natural groups within subgenus *Pedimelum* based on calyx morphology: *P. argophyllum* (Pursh) Grimes, *P. digitatum* (Nutt. ex Torr. & A. Gray) Grimes, *P. canescens*, and *P. aromaticum* (Payson) W.A. Weber appear to be a closely related group of species, with broadly and shallowly campanulate fruiting calices. *Pedimelum piedmontanum*, however, with a narrower, gibbous-campanulate calyx, would fall into the other group from *P. canescens*.

The following modification of Grimes' (1990) *Pedimelum* key to include *P. piedmontanum*, requiring only the expansion of a single couplet, provides a summary of the most conspicuous distinctions from *P. canescens*:

7. Petioles less than 7 mm, or lacking, shorter than the petiolules.
 Inflorescence loose (much of the axis exposed); leaflets 1–3, less than twice as long as wide, petiolules 5–9 mm; of sandy habitats in the Coastal Plain _____ **P. canescens**
 Inflorescence congested (the axis usually concealed); leaflets 3(–5), more than twice as long as wide, petiolules 1.8–3 mm; of rocky habitats in the Piedmont _____ **P. piedmontanum**
7. Petioles longer than 7 mm, or if rarely that short, always equal to or longer than petiolules _____ (*P. cuspidatum* et al.)

Demonstrating major differences from *Pedimelum canescens* does not test the alternative hypothesis that the Piedmont plants constitute a subsessile-leaved variant of a more western species. To rule this out, we compared the Piedmont plants to the descriptions in Ockendon (1965) and Grimes (1990) of all known *Pedimelum* taxa. We found that there are always multiple characters separating the new species from each of its other congeners. For example, *P. piedmontanum* is similar to *P. canescens* in its strongly beaked fruit, small corollas, and subsessile leaves; like only *P. reverchonii* (S. Wats.) Rydb. in its enlarged bracts (causing the Piedmont plants to key to that species in Rydberg 1919–20); and like both *P. cuspidatum* and *P. esculentum* in having many-flowered inflorescences. At the same time, *P. cuspidatum* differs by its much shorter

fruit-beak from both *P. esculentum* and *P. piedmontanum*, while *P. esculentum* has larger corollas, on average, than any of these, besides being uniquely eglandular. In short, our comparison of *P. piedmontanum* with all recognized species of *Pediomelum* indicates that the new taxon is too distinctive to be treated at varietal or subspecific rank, under *P. canescens* or any of the more western species.

Additional research into the systematic relationships, population structure, etc. of *Pediomelum piedmontanum* is underway or is planned for the near future, including, as part of ongoing investigations by Egan of the psoraleoid legumes, a molecular phylogenetic analysis to determine the closest congener for *P. piedmontanum*, and a study of the population genetics of the new species, based on DNA sequences.

HABITAT AND ECOLOGY

The Georgia and South Carolina localities where *Pediomelum piedmontanum* has been found are all located about 20–25 kilometers north of the Fall Line, the name commonly used for the boundary between the Piedmont and Coastal Plain physiographic provinces. At all three of the known occurrences, metamorphic rock is exposed in places, including serpentinite at the Georgia locality (Cocker 1991a, 1991b) and phyllite at the South Carolina sites (Secor & Wagener 1968a, 1968b). Bedrock in these locations appears to be relatively close to the surface over an area of at least a few hectares, extending beyond the actual outcrops. This is inferred from the plant communities, with the openings dominated by drought-tolerant grasses and forbs, such as *Schizachyrium scoparium* (Michx.) Nash and *Hypericum gentianoides* (L.) B.S.P., and the adjacent, thinly-stocked woodlands dominated by drought-tolerant pines and oaks, such as *Pinus echinata* P. Mill., *P. taeda* L., *Quercus falcata* Michx., *Q. stellata* Wangenh., and *Q. marilandica* Muenchh.

Most of the biomass at all sites is composed of fairly widespread species that are frequent in dry, rocky sites of the lower Piedmont. A few relatively infrequent taxa, however, particularly when common to sites in both Georgia and South Carolina, may have some value as indicator species (their occurrences indicating potential habitat for the *Pediomelum*). *Baptisia bracteata* Muhl. ex Ell. and *Vernonia acaulis* (Walt.) Gleason fall into this category. Among species recorded from the Richland County site, the uncommon *Hypericum lloydii* (Svens.) P. Adams may also have some indicator value.

The mix of woody plants and particularly the composition of the herbaceous layer suggest that the soil at these *Pediomelum* sites is somewhat acidic and low in fertility. This was borne out by samples of topsoil, each collected adjacent to a plant of *P. piedmontanum*, that we sent to the University of Georgia Soil Testing Lab for analysis, two from the Georgia locale and one from each of the South Carolina sites. Because of the small number of samples, we refrain

at this time from offering definitive comparisons of soil chemistry among the sites, but all samples had an acidic pH value (4.0–6.2). If the new species were restricted to the Georgia site, as was formerly believed (Allison et al. 2003), its rarity could be easily explained as reflecting adaptation to soil derived from serpentinite, a rock rarely exposed in the eastern United States south of Maryland (Tyndall & Hull 1999). The high levels of magnesium and toxic heavy metals (e.g., chromium and nickel) characteristic of serpentine barrens were reflected in our Georgia test samples, but their concentrations were not nearly as elevated in the samples from the two South Carolina sites. For comparison, we also submitted a soil sample taken from about 9 km southwest of the type locality, from the margin of an outcrop of granite, an abundant rock in the Piedmont. For the pH and the elements named above (Mg, Cr, Ni), as well as for most of the other elements measured, the values returned from the South Carolina samples were more similar to those from the regionally abundant granite outcrop habitat than from the regionally rare serpentinite outcrop of the Georgia type locality. In short, the factors responsible for the apparent extreme rarity of *Pediomelum piedmontanum* are not known at present.

Our observations of the relative vigor of plants indicate that, like the great majority of its associates as well as the other members of subgenus *Pediomelum*, *P. piedmontanum* is a heliophyte. Vigor in the new *Pediomelum* is strongly correlated with the amount of sunlight, with plants growing in the open generally larger and more floriferous than the partly shaded plants growing in the adjacent woodlands. The sizeable, deep-reaching root systems of *P. piedmontanum* and its relatives surely provide both a capacity for underground storage that protect them against drought, while also placing their shoot-meristems mostly out of reach of wildfires, permitting rapid regrowth to take advantage of suddenly reduced competition for light, water, and nutrients. As stated earlier, the famously fire-adapted *Pinus palustris* has persisted at the Georgia type locality, despite fairly effective exclusion of fire at the site for decades. It seems likely that at the South Carolina sites there are (or were at one time) natural openings, long-persistent due to shallowness and infertility of soil, that were prevented in the past from total closure by occasional fires. It is apparent that the controlled use of fire should be a primary management tool for the protection and enhancement of populations of *Pediomelum piedmontanum*.

In terms of pollination ecology, papilionoid flowers like those of *Pediomelum piedmontanum* are considered the product of natural selection reflecting entomophily. A detailed study of pollinators has not been undertaken, but Morris observed various insects visiting the flowers on June 2, 2002, including bees (probable *Bombus* spp.) and several species of butterflies, including the pipevine swallowtail (*Battus philenor*), eastern tailed blue (*Everes comyntas*), buckeye butterfly (*Junonia coenia*), and dusky winged skippers

(*Erynnis* spp.). The larvae of two of these (*Everes comyntas*, *Erynnis* spp.) have been recorded as feeding upon one or more legume genera (Klots 1951).

CONSERVATION STATUS

Pedimelum piedmontanum appears to be a very rare species. It is difficult to imagine that such a striking and distinctive plant, relatively large among the herbaceous legumes of its region, could be merely uncommon and yet be represented in herbaria by so few specimens. Indeed, publication has been delayed until now in part by our concern that the outcome might include its extirpation by collectors. That concern has been only slightly reduced by the increase in the number of known sites to three, from the single one known at the time of Allison et al. (2003).

According to NatureServe's global conservation status ranking, a system very similar to the IUCN Redlist criteria, *Pedimelum piedmontanum* would be classified as Critically Imperiled (Global Rarity Rank = G1), a rank that should be qualified with a question mark (G1?), indicating that the taxon is not well known enough to assign a rarity rank with confidence. The chief source of doubt is the fact that Egan found the Lexington County population quite serendipitously, offering hope that there are at least a few other populations awaiting discovery. We plan to search for such populations, especially in South Carolina. We will also seek partnerships with landowners, land managers, and conservation agencies/NGOs to protect and enhance the known localities.

As there is no guarantee that protection of any of the sites will be possible, we have taken the precaution of twice collecting seeds from the type locality and providing them to the Atlanta Botanical Garden. The first batch of seeds has already yielded a few plants. We intend to work with the ABG and others to use these and future production to establish one or more experimental populations, in locations near the type locality and with similar edaphic characteristics. We do not consider that such efforts can be assumed to be sufficient to guarantee the long term survival of *Pedimelum piedmontanum*, however, and we urge an expedited consideration of its listing under the federal Endangered Species Act and corresponding state laws.

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